Posterior Reversible Encephalopathy Syndrome after Transsphenoidal Resection of Pituitary Macroadenoma

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Introduction

Posterior Reversible Encephalopathy Syndrome (PRES) is a well described final common pathway for a number of pathogenic mechanisms affecting the blood brain barrier. PRES is typically characterized by posterior location (e.g., occipital lobes), a reversible neurological deficit (due to vasogenic edema), and encephalopathy (e.g., homonymous hemianopsia or cortical visual loss, headache, altered consciousness, and seizures) (1). Atypical PRES however may be anterior rather than posterior in location, may cause irreversible (due to cytotoxic edema) damage rather than being fully reversible), and may not have encephalopathy. Though many drugs and predisposing factors have been implicated, the most common risk factor for PRES development is acute, severe hypertension (2). Other associated conditions include preeclampsia/eclampsia, sepsis, autoimmune disease, chemotherapy, and/or solid-organ or bone marrow/stem cell transplantation (3). The diagnosis is made clinically and is supported by magnetic resonance imaging (MRI) showing typical white matter changes and diffusion weighted imaging (DWI) showing vasogenic (rather than cytotoxic) edema in the posterior parietal and occipital lobes (4). Several mechanisms have been proposed, but ultimately the pathophysiological basis appears to be linked to failure of proper cerebral vascular autoregulation (5).

PRES following neurosurgical procedures is distinctly rare and has been reportedly only once previously after transsphenoidal surgery (TSS). To our knowledge, this is only the second such case to be reported in the neurosurgical or ophthalmic English language literature.
Case Report

A 51-year-old female presented with visual loss for several months and was diagnosed with a suprasellar mass. The past medical, surgical, social, and family history was negative. She was taking no medications and had no allergies. Her blood pressure prior to surgery was normal. Pre-operative MRI showed a 2.7 x 2.5 x 29 cm in the anterior-posterior (AP), transverse, and craniocaudal dimension mass in the suprasellar region with displacement and compression of the optic chiasm (Fig 1.). Preoperative eye examination showed normal visual acuity (20/20 OU) but a dense bitemporal hemianopsia (Humphrey visual field 24-2: Figure 2) with associated optic atrophy OU on exam and on optical coherence tomography (OCT).

A peri-procedural lumbar drain was inserted prior to surgery. The patient was positioned in park-bench position with tumor and sellar localization performed with intraoperative navigation and fluoroscopy. A radical subtotal excision was achieved with good decompression of the optic apparatus. A small intraoperative CSF leak was noted at the base of the tumor capsule which was sealed intraoperatively and a fat graft was placed. Pre-operative and intraoperative blood pressure measurements were normal.

Her immediate post-operative course was uneventful, she was started on hydrocortisone taper and prophylactic antibiotics for her lumbar drain, which drained approximately 200cc’s a day. On post-operative day four, her blood pressure began climb from her baseline SBP of 120 mm Hg to 160 mm Hg sustained over 24 hours, with a maximum of 180 mm Hg. She had a concurrent headache that progressed throughout the evening and by morning she began having quickly declining vision to just light perception. Emergent CT and MRI revealed bilateral occipital hypodensity with an associated abnormal T2 FLAIR signal compatible with ongoing edema (Figure 2). A new thin subdural collection was present consistent with intracranial hypotension was also noted. Notably no sinus thrombosis, pituitary apoplexy, or compression of the optic chiasm was seen.

She was transferred to the intensive care unit for 8500mg/250ml/24hrs methylprednisolone drip and strict blood pressure control to keep her systolic blood pressure between SBP 120-145 mm Hg using an antihypertensive drip. The lumbar drain was clamped and removed. Over the day, her vision improved significantly and was noted to be able to discern rough shapes. The blood pressure control and steroid drip was maintained for three days and she was noted by
formal ophthalmological exam to have improved vision from counting fingers, 20/100 OD, 20/200 OS, to OD 20/70, OS 20/60. The pupil exam was normal OU and the remainder of the eye exam including the fundus exams were normal OU. By post-operative day 10, ICU day 6, she was noted to have improved bitemporal hemianopsia and vision good enough to read and use her cellular phone. Surveillance MRI revealed resolution of previous FLAIR signal and subdural collections. She was discharged on post-operative day 14 on low dose hydrocortisone and oral antihypertensives. She was seen in both the neurosurgery and ophthalmology clinic and noted to have return of her visual acuity back to pre-operative 20/20 OU baseline. Her bitemporal hemianopsia had improved, with some residual field loss present.
Discussion

We present a case of PRES following endoscopic endonasal transsphenoidal resection of a pituitary tumor where the patient developed worsening visual disturbance and headache. Given that both visual changes and headache can be related to pituitary tumors and post-operative complications of transsphenoidal surgery (hemorrhage into the resection cavity, apoplexy, edema etc.), the immediate concern was for those entities. Emergent imaging should always be performed in post-operative patients with new deficit, and in our case stat CT and MRI were obtained. Our patient had classical bitemporal hemianopsia prior to surgery, but developed near complete blindness with only light perception following onset of PRES after surgery. Similarly, in the other case of PRES following TSS in the literature, complete blindness was observed (10). Neuro-ophthalmology consultation and formal visual field testing was obtained in our case, and we suggest the same for all patients with PRES-associated visual disturbances.

The current most accepted pathophysiological basis of PRES involves a hyperperfusion injury model related to hypertension (11). A sudden elevation in blood pressure causes critical failure of cerebral autoregulation. Arteriolar dilation and endothelial dysfunction cause disruption of the blood brain barrier and thus the resultant vasogenic edema that can be appreciated on imaging. Though this theory seems sufficient to explain PRES related to acute hypertension, it fails to address the cases (estimated at 30%) of PRES not related to hypertension (1). The other competing hypothesis implicates hypotension as a cause, where decreased blood pressure leads to reflexive vasoconstriction, cerebral ischemia and ultimately vasogenic edema. Another theory describes an immunological mechanism, where T-cell/endothelial cell activation leads to trafficking of leukocytes, cerebral vasoconstriction, hypoperfusion, ischemia and subsequent vasogenic edema (12).

Regardless of the underlying mechanism, it remains unclear how recent neurosurgical intervention plays a role in development of PRES. Case reports of PRES following neurosurgery come from a wide variety of different procedures, from cerebrovascular to neuro-oncological and beyond. Proximity of surgery to the parietal and occipital lobes does not appear to play an obvious role, especially evidenced by cases of PRES following pituitary surgery including our own. One article hypothesized sudden decrease in intracranial pressure as a possible link (8). In that article, the authors described a patient with a ruptured aneurysm
who developed PRES following successful clipping but inadvertent over-drainage from ventricular drain. The same article described another case where a patient with arachnoid cyst presenting with obstructive hydrocephalus was treated with cysto-peritoneal shunt and developed PRES following surgery characterized by altered consciousness and status epilepticus. Due to small sample size however, it is difficult to confirm whether this mechanism is truly causative or a mere coincidence.

A final point remains in treatment of PRES. While there remains much speculation on the true mechanisms behind PRES, nearly all studies support strict blood pressure control in the treatment of PRES once it has developed. In our case, the patient was maintained on strict blood pressure parameters (systolic blood pressure between 120-145). She was treated with intravenous nicardipine infusion when systolic BP was elevated beyond those parameters and with crystalloid fluid bolus when below. The result was steady improvement in headache and vision from day to day, with complete resolution within a week and return to better than baseline vision (bitemporal hemianopsia in our case). Though our patient did not suffer from seizures related to PRES, the literature supports the use of anti-epileptic drugs when applicable. Our patient was also treated with high-dose corticosteroids, which remains somewhat controversial in the literature. Some articles have demonstrated a positive effect of steroids, especially in those with significant vasogenic edema, but others have gone so far as to implicate steroids as a cause of PRES (13, 14). Though the literature is less clear on this subject, our patient certainly improved while on steroids, and we would continue to treat future patients with steroids until more conclusive literature becomes available.

Conclusions

Posterior Reversible Encephalopathy Syndrome (PRES) is a rare and serious neurological disease that may occur following neurosurgical intervention among a wide array of predisposing factors. We describe the second reported case in the literature of PRES following endoscopic endonasal TSS of pituitary adenoma. Though pathophysiological mechanisms remain debated, the consensus on treatment remains strict blood pressure control, anti-epileptic drugs where appropriate, and serial imaging and neurological examination to evaluate for resolution. Corticosteroids remain controversial, but most reports seem to demonstrate a positive effect, especially with regards to vasogenic edema. We report a favorable outcome in our patient, which we owe to timely diagnosis and medical management.
REFERENCES


Figure 1. Preoperative imaging. Contrast enhanced sagittal T1-weighted magnetic resonance image coronal (A), sagittal (B) and axial (C) Sagittal computed tomography angiogram (D) shows the pituitary adenoma with expansion of the sella turcica.

Figure 2 A) Emergent CT coinciding with progressive vision loss revealing bilateral occipital lobe hypodensity. B) MRI T2 FLAIR signal concerning for PRES in same location as hypodensity. C) Follow up MRI revealing resolving T2 FLAIR signal 6 days after initiation of blood pressure control, steroids, and removal of lumbar drainage.
Figure 3. Pre-operative visual fields with classical dense bitemporal hemianopsia on Humphrey visual fields.